Power Conversion

Formulas 2016

Table of Contents

A-2: Unitary, Heating and Cooling Unit 4

A-5: Air Conditioning Machine, Split System Chilled Water Coils (Comfort Cooling) 5

A-6: Air-Conditioning Machine, Package Unit (Comfort Cooling) 6

A-7: Air-Conditioning Machine, Package Unit (Special Purpose:Data/Server Rooms)..... 7

A-8: Air-Conditioning, Window Unit 8

A-9: Air-cooled Condenser 9

A-10: Heat Pumps 10

A-11: Air Handler Unit 11

A-12: Glycol Dry Cooler 12

A-13: Air Conditioning Unit, Ceiling/Wall Mounted (Comfort Cooling) 13

A-13: Air Conditioning Unit, Ceiling/Wall Mounted (Special Purpose: Data/Server Room) 14

C-9: Cooling Tower 15

C-24: Condensing Unit, Refrigeration 16

F-27: Fan, Centrifugal 17

I-4: Fan Coil Unit, Ceiling/Wall Hung (DX Unit) 18

I-4: Fan Coil Unit, Ceiling Hung (Chilled water unit) 19

R-4, R5, R6,or R7: Refrigeration Machine, Centrifugal, Reciprocating and Scroll, Screw..... 20

P-4: Pump, Centrifugal 21

Conversion Tables

Electrical Horsepower to Kilowatts

Horsepower	Kilowatts	Watts
1	.746	746

Kilowatthour to BTUs

Kilowatthour	BTUs
1	3,412

1 kWh = 3,412 BTU (based on U.S. consumption, 2013)

Efficiency	HP	Watts
85%	1	.746kW/.85 = .878
90%	1	.746kW/.9 = .829

The efficiency of a motor can be found on the nameplate on the motor.

****Notes:**

- Annual Standard numbers are the suggested preventive maintenance hours associated with the selected piece of equipment for normal operations.

A-2: Unitary, Heating and Cooling Unit

Note: A-2 should always be entered as tonnage.

Enter tonnage of unit into Maintenance Feeder. (Check for oil or gas consumption).

	Conversion Rates for A-2
85%	.746kW/.85 + .5kW for Associated Equipment = **1.378kW/ton**
90%	.746kW/.9 + .5kW for Associated Equipment = **1.329kW/ton**

A-2 Associated Equipment: Blower motor, condenser fan motor/s, Damper motor/s, crankcase heater.

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	3.5

A-5: Air Conditioning Machine, Split System Chilled Water Coils (Comfort Cooling)

Note: Tonnage represents the hp of the blower motor. A/C tons will be picked up on associated R-4, R-5, R-6, or R-7. Enter tonnage of unit into Maintenance Feeder.

	Conversion Rates for A-5
85%	.746kW/.85 + .2kW/ton for Associated Equipment = **1.078kW/ton**
90%	.746kW/.9 + .2kW for Associated Equipment = **1.029kW/ton**

A-5 Associated Equipment: Blower motor

OPTION 1: Create a line item in the Additional Program Equipment Page for "Server/Computer Equipment" enter the total kW for cooling from the Equipment Costs Page as the kW for the Server/Computer Equipment, and set the load time for 75% and the runtime at 100%.

OPTION 2: Enter tonnage of the unit into the program.
A/C tons will be picked up on an assoc. R-4, 5,6,or7. Tonnage here represents the load of the special purpose area and the hp of the blower motor. Only 70% of the installed tonnage in a special purpose area is the actual load of the special purpose area. The 12,000btu/ton/hr figure is the amount of refrigeration required to remove the heat generated by the special purpose area. The 3,412btu/kW/hr figure is the amount of heat that 1 kW will generate. By dividing the two; and multiplying by the actual load; and then adding the blower motor kW, we can calculate the total special purpose area load.

$$\frac{12{,}000 \text{ Btu/ton/hr}}{3412 \text{ Btu/kW/hr}} \times 70\% \text{ (actual load)} + .20\text{kW/ton one quarter horse per ton. (blower motor)} = \mathbf{2.66} \text{ kW/ton}$$

*********When using the 2.66 conversion factor, do not charge plug load for the square footage of the special purpose area served.**

Annual Standard:

Size	Annual Preventative Maintenance Hours
COMFORT COOLING 10 TONS AND UNDER	3
COMFORT COOLING OVER 10 TONS	6
SPECIAL PURPOSE TEN TONS AND UNDER	18
SPECIAL PURPOSE OVER TEN TONS	36

A-6: Air-Conditioning Machine, Package Unit (Comfort Cooling)

Enter tonnage of unit into Maintenance Feeder.

	Conversion Rates for A-6
85%	.746kW/.85 + .5kW for Associated Equipment = **1.378kW/ton**
90%	.746kW/.9 + .5kW for Associated Equipment = **1.329kW/ton**

A-6 Associated Equipment: Blower motor, reheat, humidifier

Annual Standard:

Size	Annual Preventative Maintenance Hours
10 TONS AND UNDER	3
OVER 10 TONS	6

A-7: Air-Conditioning Machine, Package Unit (Special Purpose:Data/Server Rooms)

Enter tonnage of unit into Maintenance Feeder.

	Conversion Rates for A-7
85%	.746kW/.85 + .5kW for Associated Equipment = **1.378kW/ton**
90%	.746kW/.9 + .5kW for Associated Equipment = **1.329kW/ton**

A-7 Associated Equipment: Blower motor, reheat, humidifier. Possible boiler.

OPTION 1: Create a line item in the Additional Program Equipment Page for "Server/Computer Equipment" enter the total kW for cooling from the Equipment Costs Page as the kW for the Server/Computer Equipment, and set the load time for 75% and the runtime at 100%.

OPTION 2: For load, the same formula is used for the special purpose area as in A-5, except, you leave out the blower motor.

$$\frac{12{,}000 \text{ Btu/ton/hr}}{3{,}412 \text{ Btu/kW/hr}} \times 70\% \text{ (actual load)} = 2.46 \text{kW/ton}$$

Add the 2.46 to the appropriate efficiency from above, such as 90% - 1.329 + 2.46 = 3.789 kW/hr.

*********When using the 3.789 conversion factor, do not charge plug load for the square footage of the special purpose area served. Reference RETA, OUET, footage.**

Annual Standard:

Size	Annual Preventative Maintenance Hours
10 TONS AND UNDER	18
OVER 10 TONS	36

A-8: Air-Conditioning, Window Unit

Note: On average, a window a/c requires one and a half hp per one ton of cooling.

Enter tonnage of unit into Maintenance Feeder.

	Conversion Rates for A-8
85%	.746kW x 1.5 = 1.119kW/ton 1.119kW / .85(Efficiency) = 1.316kW/ton 1.316kW/ton + .4kW/ton for assoc. equip. = **1.716kW/ton**
90%	.746kW x 1.5 = 1.119kW/ton 1.119kW / .90(Efficiency) = 1.243kW/ton 1.243kW/ton + .4kW for Associated Equipment = **1.643kW/ton**

A-8 Associated Equipment: Blower motors, condenser fan motor

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	1

A-9: Air-cooled Condenser

Note: Only the hp for the condenser fan motor/s is entered into Maintenance Feeder for this equipment. The associated A-6, A-13, etc. will pick up tonnage. This unit is similar to a C-24, but doesn't have a compressor unit in it.

	Conversion Rates for A-9
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
20 TONS AND UNDER	4
OVER 20 TONS	5

A-10: Heat Pumps

Note: A-10s run in heating as well as cooling season.

Enter tonnage of unit into Maintenance Feeder.

	Conversion Rates for A-10
85%	.746kW/.85 + .5kW for Associated Equipment = **1.378kW/ton**
90%	.746kW/.9 + .5kW for Associated Equipment = **1.329kW/ton**

A-10 Associated Equipment: Blower motor, condenser fan motor/s, damper Motor/s, crankcase heater, heating element

Annual Standard:

Size	Annual Preventative Maintenance Hours
UNDER 5 TONS	3
5 TO 10 TONS	6
OVER 10 TONS	9

A-11: Air Handler Unit

Note: A-11s should have associated equipment: R-4 - R7, H-1 - H5 or B-2 - B5.

Enter hp of the fan motor into Maintenance Feeder.

	Conversion Rates for A-11
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
UNDER 5000 CFM	2
5001-15,000 CFM	4.5
15,001-30,000 CFM	8.25
30,001-50,000 CFM	13.25
50,001-75,000 CFM	19.25
OVER 75,000 CFM	21.25

A-12: Glycol Dry Cooler

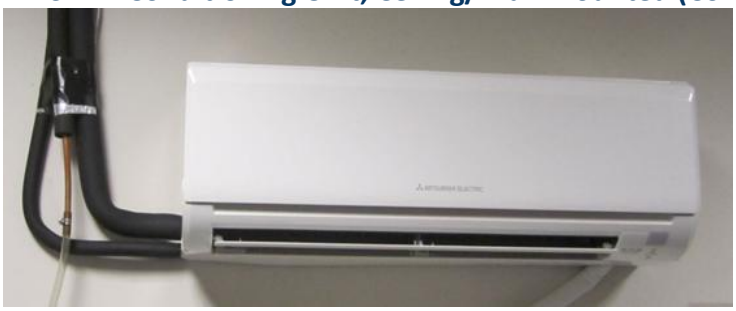
Note: Enter in the hp of the condenser fan motor(s) and any glycol pump into the program as the hp. The tonnage will be picked up by associated A-7, A-13, etc.

	Conversion Rates for A-12
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
20 TONS OR LESS	3.50
20 TO 40 TONS	4.50
EACH ADDITIONAL 10 TONS	.50

A-13: Air Conditioning Unit, Ceiling/Wall Mounted (Comfort Cooling)



Enter tonnage of the unit into Maintenance Feeder.

	Conversion Rates for A-13
85%	.746kW/.85 + .2kW Associated Equipment = **1.078kW/ton**
90%	.746kW/.9 + .2kW for Associated Equipment = **1.029kW/ton**

A-13 Associated Equipment: Blower motor

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	3

A-13: Air Conditioning Unit, Ceiling/Wall Mounted (Special Purpose: Data/Server Room)

Enter tonnage of the unit into Maintenance Feeder.

	Conversion Rates for A-13 (Special Purpose: Data/Server Room)
85%	.746kW/.85 + .5kW for Associated Equipment = **1.378kW/ton**
90%	.746kW/.9 + .5kW for Associated Equipment = **1.329kW/ton**

A-13 Associated Equipment: Blower motor, reheat, humidifier

OPTION 1: Create a line item in the Additional Program Equipment Page for "Server/Computer Equipment" enter the total kW for cooling from the Equipment Costs Page as the kW for the Server/Computer Equipment, and set the load time for 75% and the runtime at 100%.

OPTION 2: For load, the same formula is used for the special purpose area as in A-5, except, you leave out the blower motor.

$$\frac{12{,}000 \text{ Btu/ton/hr}}{3{,}413 \text{ Btu/kW/hr}} \times 70\% \text{ (actual load)} = 2.46 \text{kW/ton}$$

Add the 2.46 to the appropriate efficiency from above, such as 90% - 1.329 + 2.46 = 3.789 kW/hr.

*********When using the 3.789 conversion factor, do not charge plug load for the square footage of the special purpose area served. Reference RETA, OUET, footage.**

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	18

C-9: Cooling Tower

Only enter **fan motor hp** into Maintenance Feeder.

	Conversion Rates for C-9
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
UNDER 50 TONS	46.00
50 TO 500 TONS	90.00
501 TO 1,000 TONS	130.00
FOR EACH 500 TON INCREMENT	30.00

C-24: Condensing Unit, Refrigeration

Only the hp of the condenser fan motor/s is entered in the Maintenance Feeder. Tonnage is picked up by an associated I-4, A-13, etc. Some of these units have the compressor located internally, typical of a residential unit.

	Conversion Rates for C-24
85%	.746kW/.85 = **.878kW/hp + assoc. equipment**
90%	.746kW/.9 = **.829kW/hp + assoc. equipment**

C-24 Associated Equipment: Compressor(If present)

Annual Standard:

Size	Annual Preventative Maintenance Hours	
	COMFORT COOLING	SPECIAL PURPOSE
25 TONS AND UNDER	5.50	33.00
OVER 20 TONS	7.00	42.00

F-27: Fan, Centrifugal

Only enter fan motor hp into Maintenance Feeder.

	Conversion Rates for F-27
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
UNDER 5,000 CFM	1.00
5,001-10,000 CFM	1.30
10,001-15,000 CFM	1.60
15,001-20,000 CFM	1.95
FOR EVERY 5,000 CFM OVER 20,000 CFM	.30

I-4: Fan Coil Unit, Ceiling/Wall Hung (DX Unit)

Enter tonnage of the unit into Maintenance Feeder.

	Conversion Rates for I-4
85%	.746kW/.85 + .2kW Associated Equipment = **1.078kW/ton**
90%	.746kW/.9 + .2kW for Associated Equipment = **1.029kW/ton**

I-4 Associated Equipment: Blower motor

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	1

I-4: Fan Coil Unit, Ceiling Hung (Chilled water unit)

Only enter the hp of the blower motor into Maintenance Feeder. The tonnage will be picked up by associated R-4, 5,6,or7.

	Conversion Rates for I-4
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
ALL	1

R-4, R5, R6,or R7: Refrigeration Machine, Centrifugal, Reciprocating and Scroll, Screw

Enter tonnage of the unit into Maintenance Feeder.

	Conversion Rates for R-4, R-5, R-6,or R-7 (Less Energy Efficient Chillers)
85%	.746kW/.85 + .3kW for Associated Equipment = **1.178kW/ton**
90%	.746kW/.9 + .3kW for Associated Equipment = **1.129kW/ton**

Associated Equipment: purge, crankcase heater, oil pump motor

	Conversion Rates for R-4, R-5, R-6,or R-7 (More Energy Efficient Chillers)
150-299 TONS	.59**kW/ton**
300-2000 TONS	.56**kW/ton**

**Higher Energy Efficient Chiller numbers pulled from ARI Standard 550/590-98.

Annual Standard:

Size	Annual Preventative Maintenance Hours	
	COMFORT COOLING	SPECIAL PURPOSE
25 TONS AND UNDER	18.00	54.00
25 TO 50 TONS	26.00	78.00
51 TO 75 TONS	34.00	102.00
76 TO 100 TONS	42.00	126.00
101 TO 150 TONS	50.00	150.00
FOR EVERY ADDITIONAL 50 TONS	8.00	24.00

P-4: Pump, Centrifugal

Only enter motor hp into Maintenance Feeder.

	Conversion Rates for P-4
85%	.746kW/.85 = **.878kW/hp**
90%	.746kW/.9 = **.829kW/hp**

Annual Standard:

Size	Annual Preventative Maintenance Hours
25 - 100 HP	5.50
OVER 100 HP	6.50